

MENSURATION

(P1 + P2) (20 MARKS)

Memorized $\left\{ \begin{array}{l} \text{Graphical} \\ \text{Stats} \\ \text{Trig} \\ \text{Men} \end{array} \right\}$ 90+

Some Formulas will be given on the formula sheet in exam.

FORMULAS

UNIT
CONVERSIONS

SIMILARITY

2-D

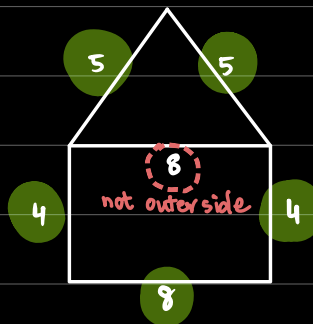
AREA

You will have
to memorize
the formulas.

PERIMETER

↓
DO NOT MEMORIZE ANY
FORMULA FOR PERIMETER.

Def: SUM OF ALL OUTER SIDES

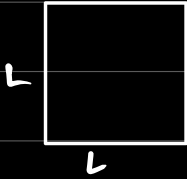


$$P = 5 + 5 + 4 + 4 + 8$$

$$P = 26$$

1 SQUARE

$$\text{Area} = L \times L = L^2$$



Perimeter: Do not memorize this formula. This is just for practice.

$$P = L + L + L + L = 4L$$

2

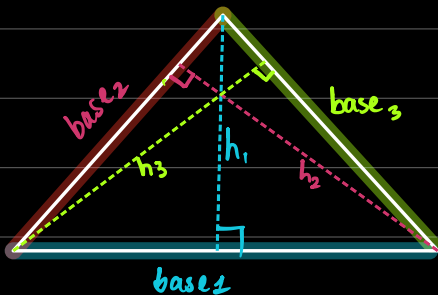


$$\text{Area} = L \times w$$

$$\begin{aligned} P &= L + L + w + w \\ &= 2L + 2w \\ &= 2(L + w) \end{aligned}$$

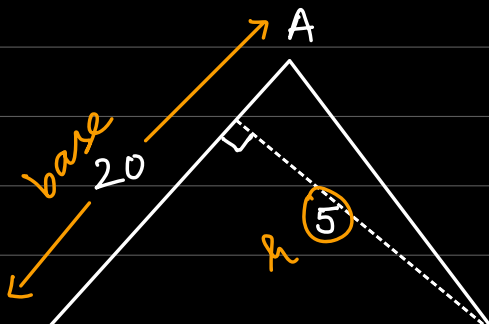
3

AREA OF TRIANGLE



$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$$

$h = 90^\circ$ distance from THIRD point on base line.

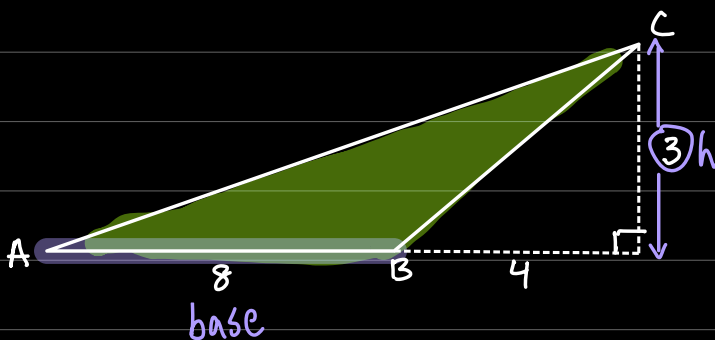
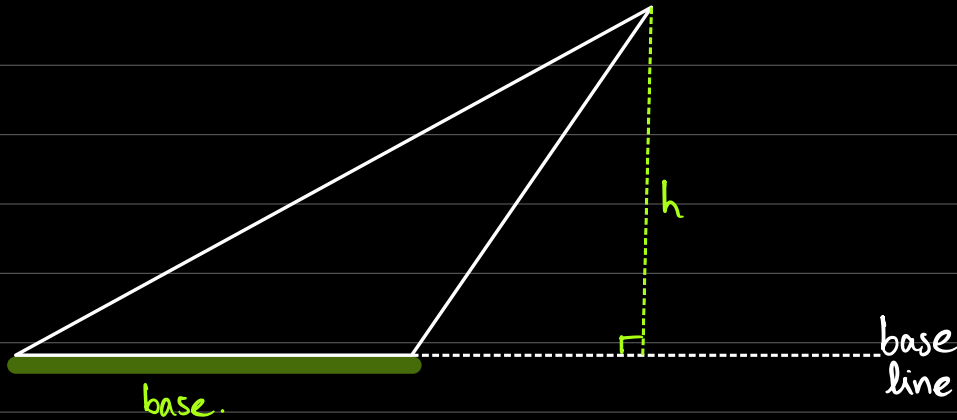


Find area of $\triangle ABC$.

$$\begin{aligned} A &= \frac{1}{2} \times b \times h \\ &= \frac{1}{2} \times 20 \times 5 = 50 \end{aligned}$$



SPECIAL TRIANGLE TO REMEMBER



Find area of Triangle ABC .

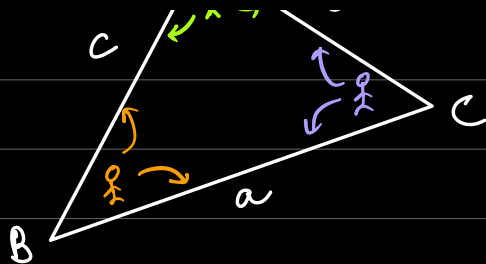
$$A = \frac{1}{2} \times b \times h$$

$$A = \frac{1}{2} \times 8 \times 3 = 12$$

IF NO PAIR OF CORRECT BASE AND HEIGHT IS GIVEN:



$$A = \frac{1}{2} \square \square \sin(\square)$$



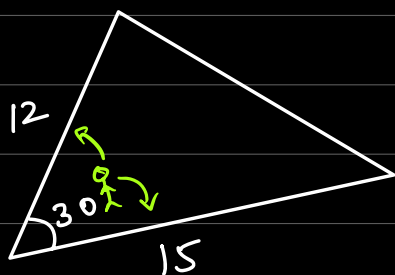
2 neighboring sides of that angle. Angle

$$A = \frac{1}{2} \boxed{c} \boxed{b} \sin(\boxed{A})$$

$$A = \frac{1}{2} \boxed{a} \boxed{c} \sin(\boxed{B})$$

$$A = \frac{1}{2} \boxed{a} \boxed{b} \sin(\boxed{C})$$

11.

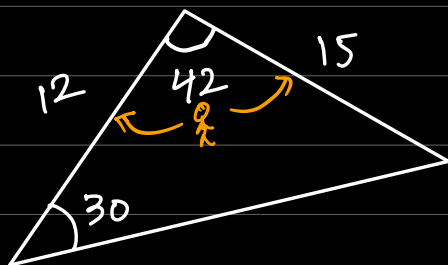


Find area of Triangle.

$$A = \frac{1}{2} \boxed{12} \boxed{15} \sin(\boxed{30})$$

$$= 45$$

Q.



Find area of triangle.

$$A = \frac{1}{2} \boxed{12} \boxed{15} \sin(\boxed{42})$$

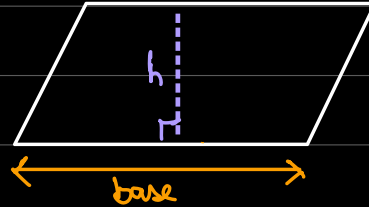
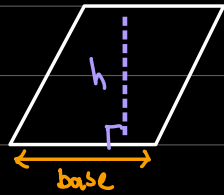
$$= 60.22$$

4

RHOMBUS

&

PARALLELOGRAM



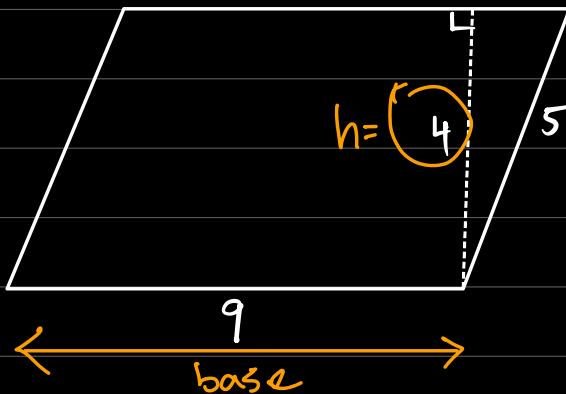
In Rhombus and parallelogram the opposite angles are equal.

$$\text{Area} = \text{Base} \times h$$



$h = 90^\circ$ distance between parallel lines.

Q

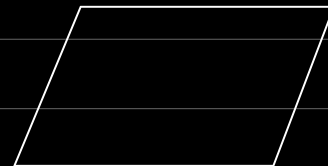


Find area of parallelogram.

$$A = b \times h$$

$$A = 9 \times 4$$

$$A = 36$$



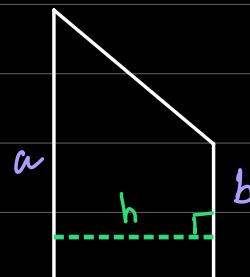
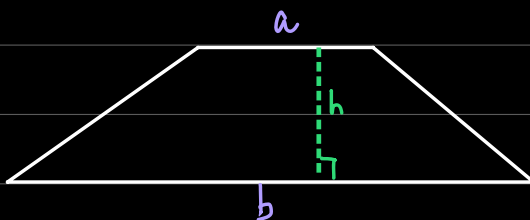
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TRAPEZIUM

Mensuration

Kinematics

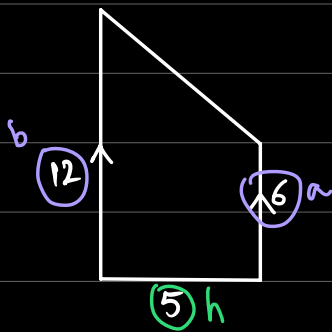
(Two sides are parallel, two sides not parallel)



$\rightarrow h = 90^\circ$ distance between parallel sides.

$$A = \frac{1}{2} \times h \times (\text{sum of parallel sides})$$

$$A = \frac{1}{2} \times h \times (a + b)$$

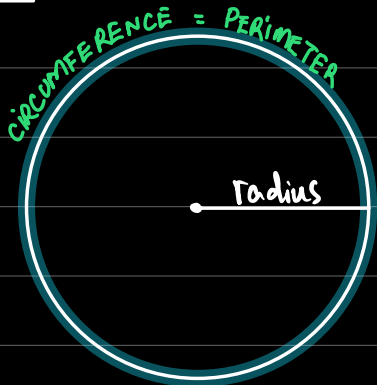


$$\text{Area} = \frac{1}{2} \times h \times (a + b)$$

$$= \frac{1}{2} \times 5 \times (6 + 12)$$

$$= 45$$

6 CIRCLE



$$\text{Area} = \pi r^2$$

$$\text{Perimeter} = 2\pi r$$

↓
Circumference

Calculator paper:

Use π on calculator:

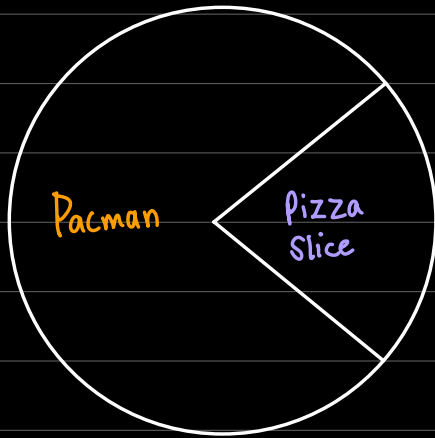
SHIFT

MIDDLE BUTTON ON BOTTOM LINE

Non-calculator:

Question will tell us value of π

If question is silent, keep writing π until it gets cancelled in the end.



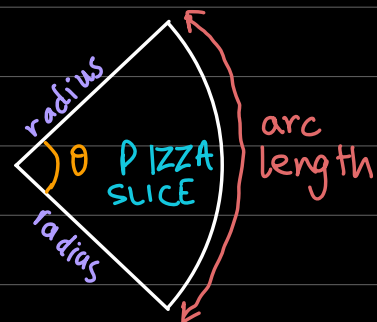
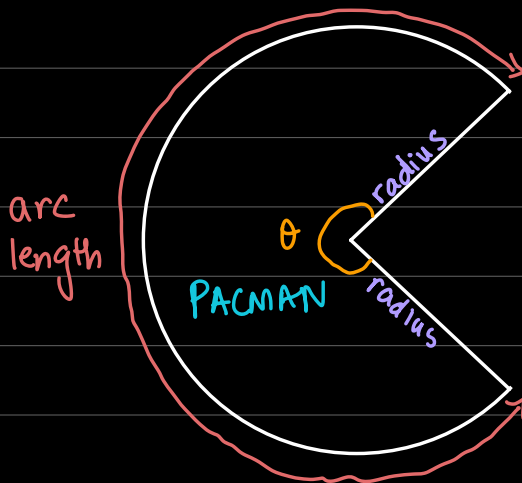
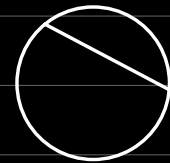
SECTORS



SEGMENTS

Chord: Any line that touches circle twice

θ = symbol for angle



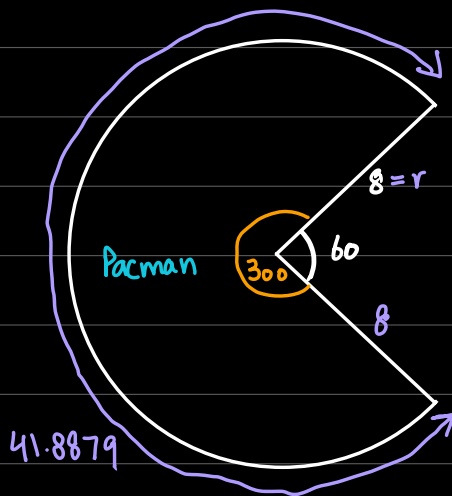
SECTORS

Pacman and Pizza slice are good friends. They use the exact same formulas.

$$\text{Arc length} = \frac{\theta}{360} \times 2\pi r$$

$$\text{Area of Sector} = \frac{\theta}{360} \times \pi r^2$$

Q:



(i) Find area of sector.

$$\text{Area} = \frac{\theta}{360} \times \pi r^2 = \frac{300}{360} \times \pi (8)^2 = 167.5516$$

(ii) Find arc length

$$\text{Arc length} = \frac{\theta}{360} \times 2\pi r = \frac{300}{360} \times 2\pi (8) = 41.8879$$

(iii) Find perimeter of Sector

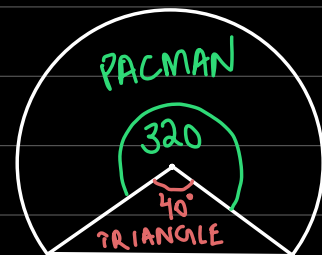
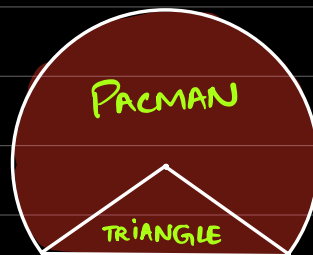
$$p = 8 + 8 + 41.8879$$

$$p = 57.8879$$

V.IMP

SEGMENTS

Area of major segment

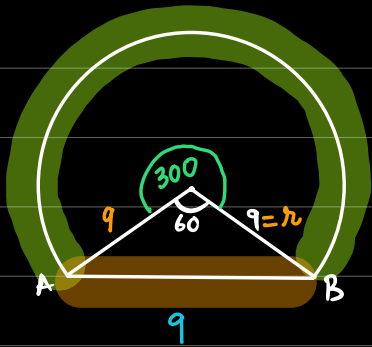


$$\text{Area of major Segment} = \text{PACMAN} + \text{TRIANGLE}$$

$$\left(\frac{\theta}{360} \times \pi r^2 \right) + \left(\frac{1}{2} \square \square \sin \theta \right)$$

NOTE: IN MAJOR SEGMENT, PACMAN AND TRIANGLE BOTH USE TWO DIFFERENT ANGLES

(2012) Find THE AREA OF MAJOR SEGMENT (4 MARKS)

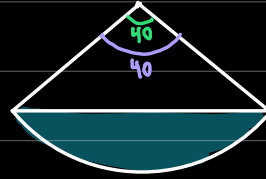
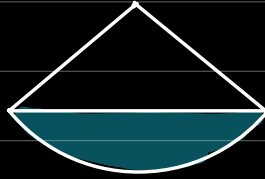
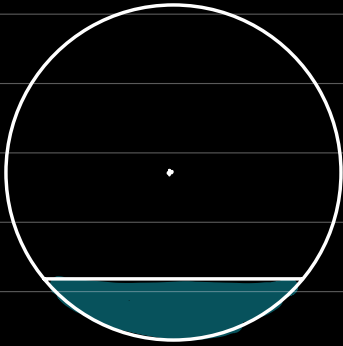


$$\begin{aligned}
 \text{MAJOR SEGMENT} &= \text{PACMAN} + \text{TRIANGLE} \\
 &= \left[\frac{\theta}{360} \times \pi r^2 \right] + \left[\frac{1}{2} \square \square \sin \angle \right] \\
 &= \left[\frac{300}{360} \times \pi (9)^2 \right] + \left[\frac{1}{2} \square 9 \square \sin(60) \right] \\
 &= 212.0575 + 35.074 \\
 &= 247.1315
 \end{aligned}$$

(ii) Find perimeter of this shape:

$$\begin{aligned}
 P &= \text{Arc length} + AB \quad \rightarrow \text{if any one angle of an isosceles } \triangle \text{ is } 60, \text{ it becomes equilateral.} \\
 &= \left[\frac{300}{360} \times 2\pi(9) \right] + 9 \\
 &= 47.1239 + 9 \\
 &= 56.1239
 \end{aligned}$$

AREA OF MINOR SEGMENT

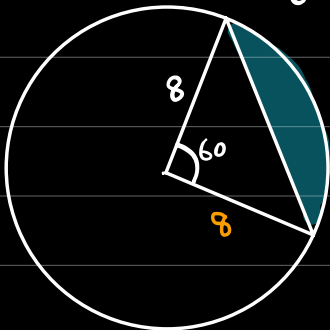


MINOR SEGMENT = PIZZA SLICE - TRIANGLE

$$\left[\frac{\theta}{360} \times \pi r^2 \right] - \left[\frac{1}{2} \square \square \sin \theta \right]$$

NOTE: FOR MINOR SEGMENT, BOTH TRIANGLE AND PIZZA SLICE USE SAME ANGLE.

Find area of shaded region



MINOR SEGMENT = PIZZA - TRIANGLE

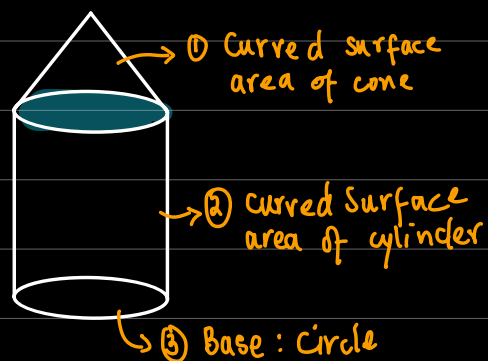
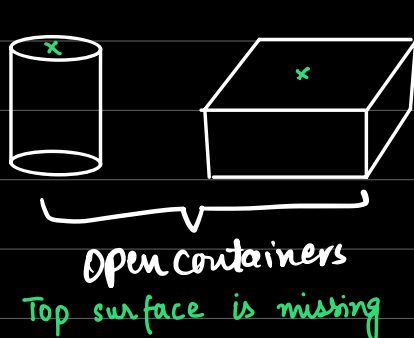
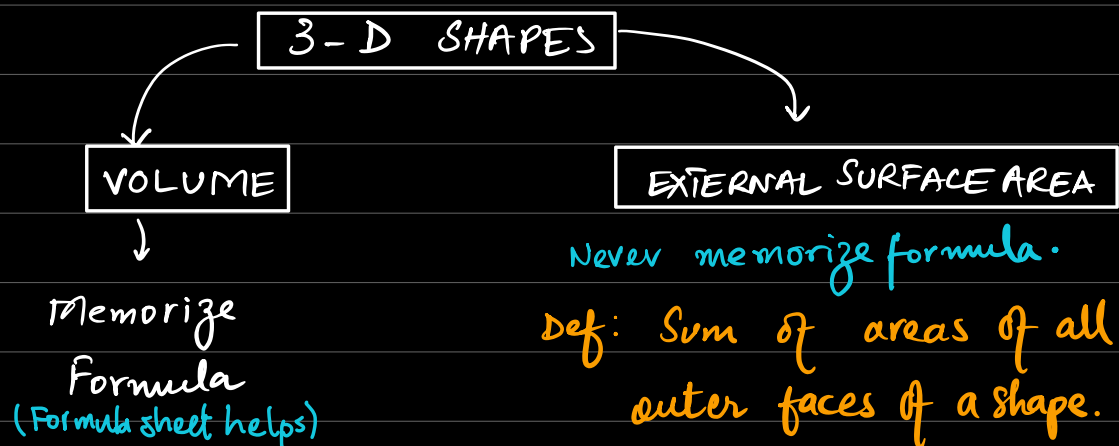
$$= \left[\frac{\theta}{360} \times \pi r^2 \right] - \left[\frac{1}{2} \square \square \sin \theta \right]$$

$$= \left[\frac{60}{360} \times \pi (8)^2 \right] - \left[\frac{1}{2} [8][8] \sin 60 \right]$$

$$= 33.51032 - 27.7128$$

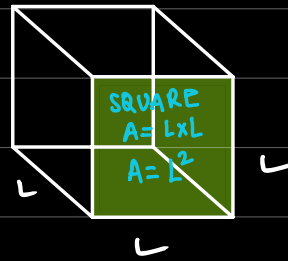
$$= 5.7975$$

Make sure to memorize all Area formulas for 2D by tomorrow.



1 CUBE

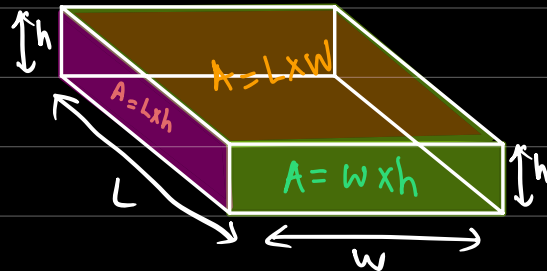
$$V = L \times L \times L = L^3$$



$$\text{Total Surface area} = 6L^2$$

2 CUBOID

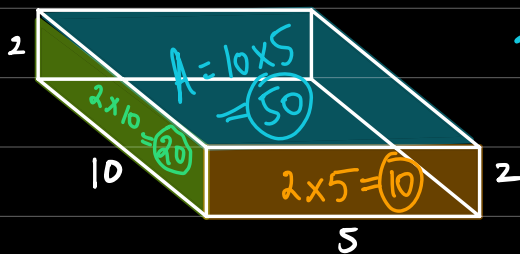
$$V = L \times w \times h$$



$$TSA = 2(L \times h) + 2(w \times h) + 2(L \times w)$$

Top face is missing.

Q. An open cuboid container is shown.
Find total external surface area?



$$10 \times 5 = 50 \quad 10 \times 2 = 20 \quad 2 \times 5 = 10$$

$$\text{Total SA} = 50 + 2(20) + 2(10)$$

$$TSA = 110$$

CYLINDER

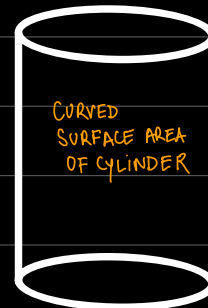
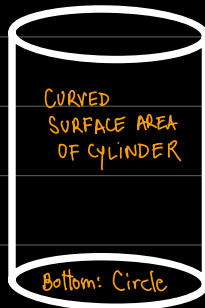
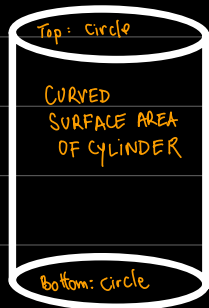
CLOSED TIN

OPEN CONTAINER

PIPE

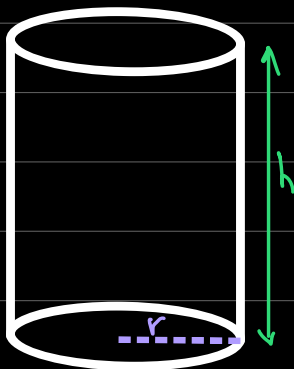
PEPSI CAN

GLASS



1) VOLUME IS SAME FOR ALL THREE TYPES.

$$\text{VOLUME} = \pi r^2 h$$



TOTAL SURFACE AREA

1) Top = circle = πr^2

2) Bottom = circle = πr^2

3) Curved Surface area of cylinder:

$$\text{CSA of cylinder} = \text{Arc length} \times h = \left[\frac{\theta}{360} \times 2\pi r \right] \times h$$

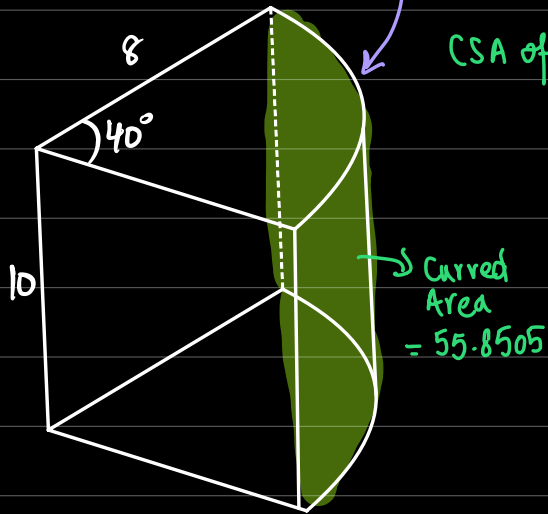
For a full cylinder: Take $\theta = 360$

$$\text{CSA} = \frac{360}{360} \times 2\pi r \times h$$

$$\text{CSA} = 2\pi r h$$

Book
Formula Sheet.

Q. Find Curved surface area of this cake slice.



$$\text{CSA of cylinder} = \text{Arc length} \times h$$

$$= \left[\frac{\theta}{360} \times 2\pi r \right] \times h$$

$$= \left[\frac{40}{360} \times 2\pi(8) \right] \times 10$$

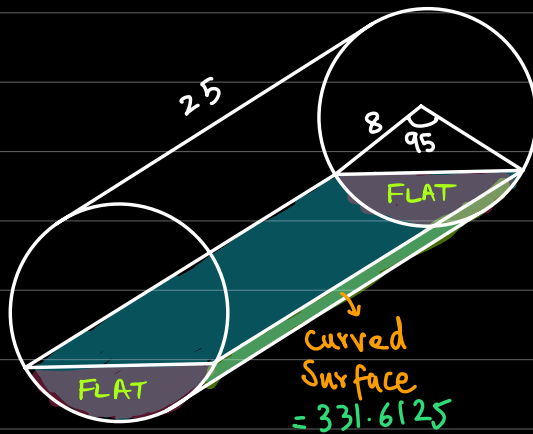
$$= 55.8505$$



Since cake is a cylinder,

we use same formulas for curved SA of cake slice too.

2



Find the curved surface area of Container in contact with water.

$$\begin{aligned}
 \text{CSA of cylinder} &= \text{Arc length} \times h \\
 &= \left[\frac{95}{360} \times 2\pi r \right] \times h \\
 &= \left[\frac{95}{360} \times 2\pi(8) \right] \times 25 \\
 &= 331.6125
 \end{aligned}$$

If: TSA in contact with water

$$TSA = 2 \text{ FLAT} + \text{CSA}$$

↓
Minor
Segment
↓
Pizza - Triangle

Topic → Study → understand → Apply → Memorize.

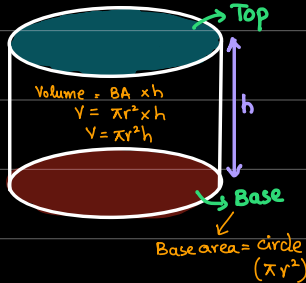
Mensuration → Study → Memorize → Apply → Understand.

Two equal parallel faces.

UPRIGHT SHAPES

PRISM

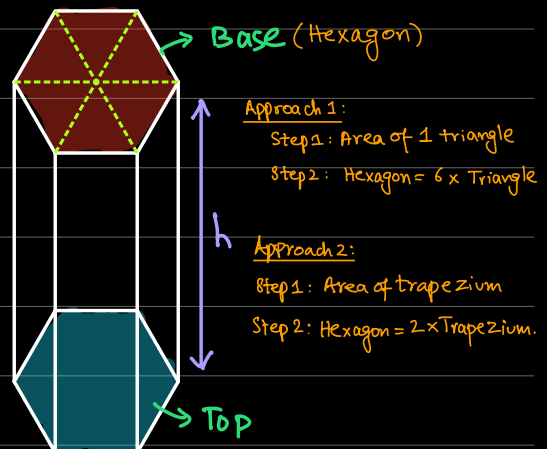
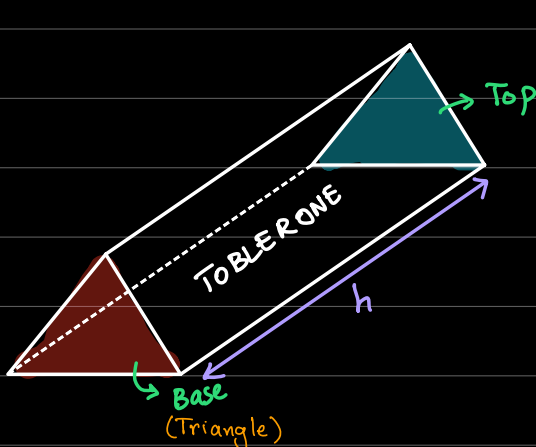
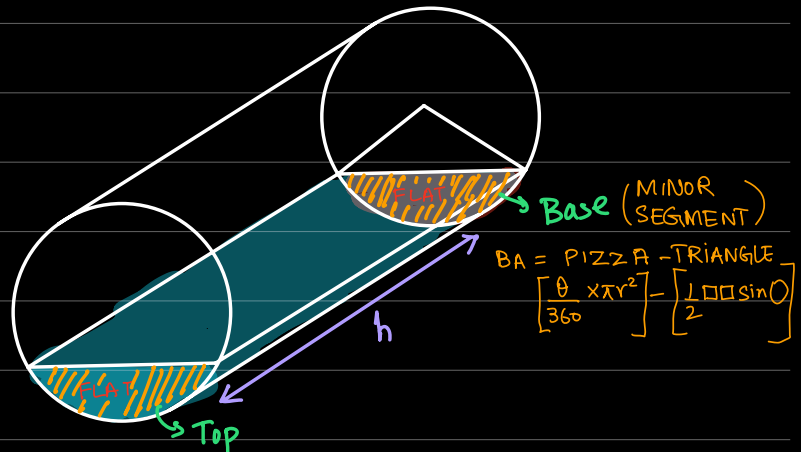
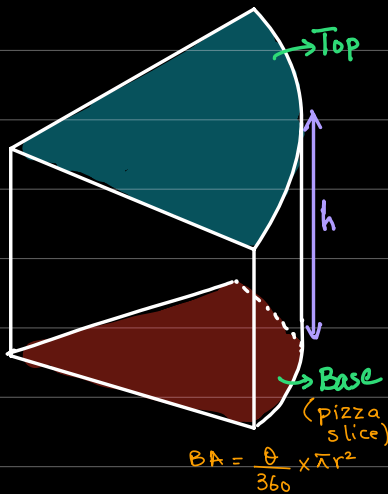
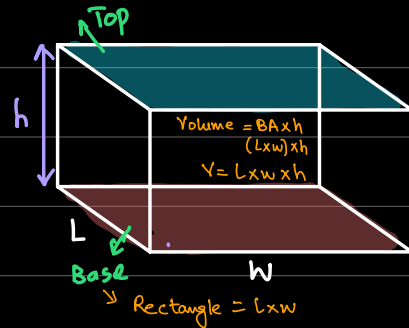
TWO EQUAL AND PARALLEL FACES.



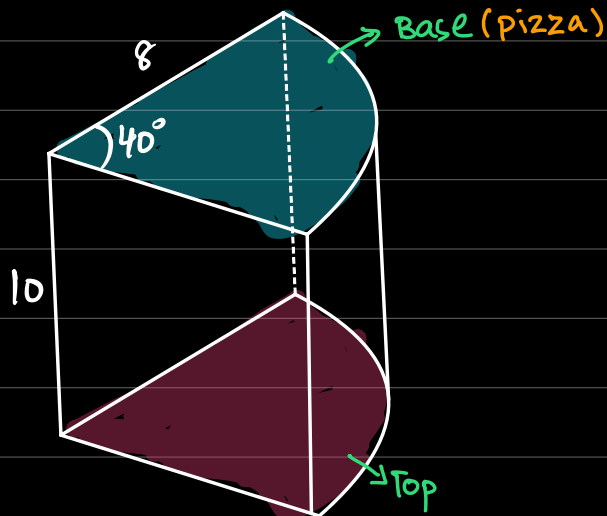
$$\text{VOLUME} = \text{Base} \times h$$

Area

Base = Area of cross-section



Find volume of this cake slice.



$$V = B A \times h$$

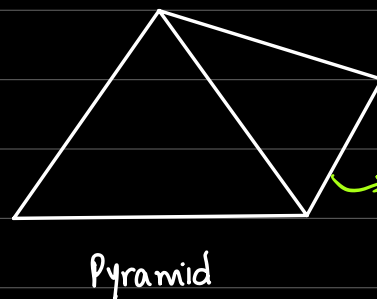
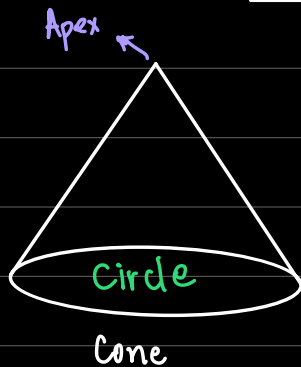
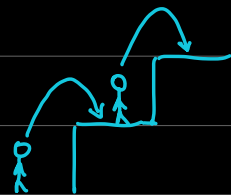
↓
Pizza

$$V = \left[\frac{\theta}{360} \times \pi r^2 \right] \times h$$

$$V = \left[\frac{40}{360} \times \pi (8)^2 \right] \times 10$$

$$V = 223.4021$$

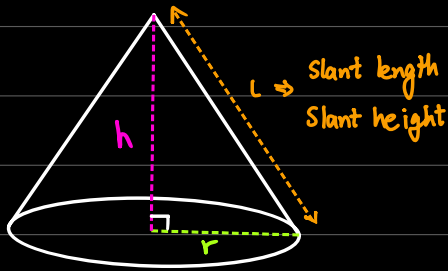
POINTED SHAPES



Base of a
Pyramid can
be any shape.

$$V = \frac{1}{3} \times \text{Base Area} \times h$$

CONE



1) Pythagoras

$$L^2 = h^2 + r^2$$

2) VOLUME

$$V = \frac{1}{3} \times \text{Base area} \times h$$

↓
circle

$$V = \frac{1}{3} \pi r^2 h$$

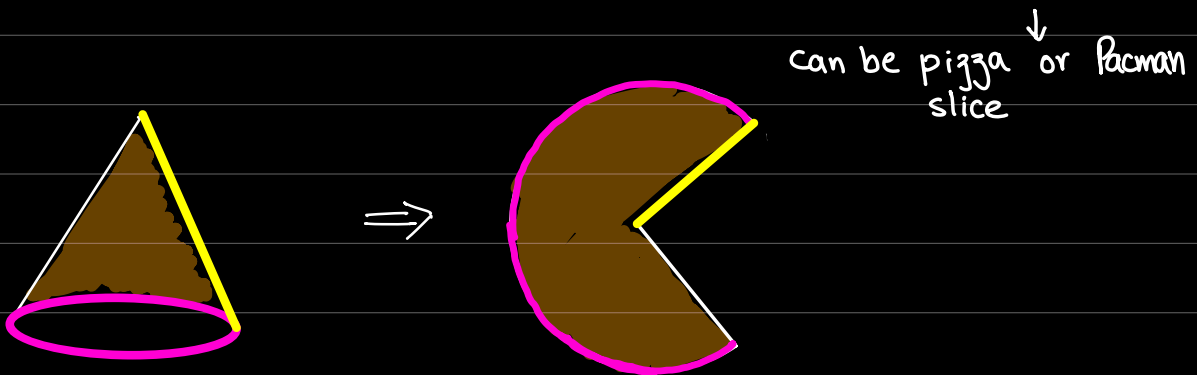
3 TOTAL SURFACE AREA :

1) Base = circle = πr^2

2) Curved Surface area of cone = $\pi r L$

WHAT HAPPENS WHEN A CONE IS OPENED???

It becomes a SECTOR

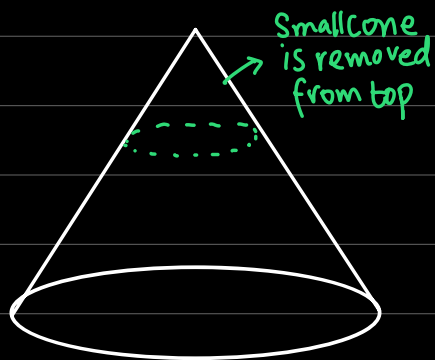


1-) SLANT HEIGHT OF CONE $\xrightarrow{\text{BECOMES}}$ RADIUS OF SECTOR

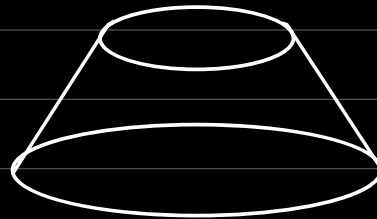
2-) CIRCUMFERENCE OF CONE BASE $\xrightarrow{\text{BECOMES}}$ ARC LENGTH OF SECTOR

3-) CURVED SA OF CONE $\xrightarrow{\text{BECOMES}}$ AREA OF SECTOR.

New addition to syllabus 2025

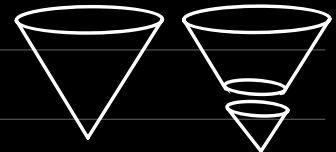


FRUSTUM



$$\text{Volume of frustum} = \text{Volume of Big cone} - \text{Volume of small cone}$$

TOTAL SURFACE AREA



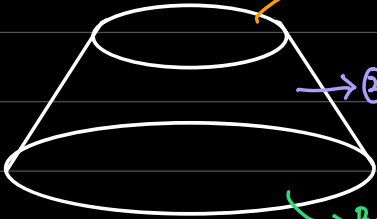
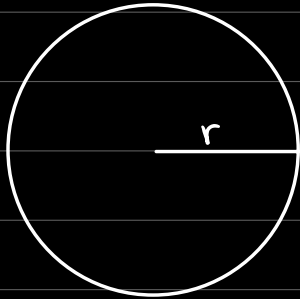


Diagram of a frustum with labels for its surface areas:

- ① Small circle = πr^2
- ② Curved SA of Frustum = CSA of Big cone - CSA of Small cone
 $(\pi RL) - (\pi rL)$
- Big circle = πR^2

SPHERES



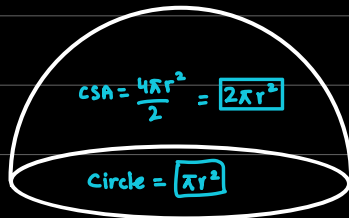
$$\text{VOLUME} = \frac{4}{3} \pi r^3$$

$$\text{Curved Surface area of sphere} = 4\pi r^2$$

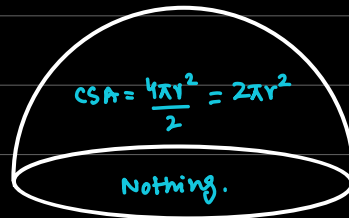
HEMISPHERE

DO NOT MEMORIZE ANY NEW FORMULAS FOR HEMISPHERES.

SOLID



HOLLOW.



BOTH HAVE SAME VOLUME:

$$V = \frac{4\pi r^3}{3} \div 2$$

CURVED SURFACE AREA

CYLINDER	CONE	SPHERE
$\text{CSA} = \text{Arc length} \times h$ For full cylinder, $\theta = 360$	$\text{CSA} = \pi r l$	$\text{CSA} = 4\pi r^2$

Till Nov 2024 : Formulas Given (cone + sphere)

From June 2025

For both 4024 and 0580

List of formulas

This list of formulas will be included on page 2 of the examination papers.

Area, A , of triangle, base b , height h .

$$A = \frac{1}{2}bh \quad \checkmark$$

Area, A , of circle of radius r .

$$A = \pi r^2 \quad \checkmark$$

Circumference, C , of circle of radius r .

$$C = 2\pi r \quad \checkmark$$

Curved surface area, A , of cylinder of radius r , height h .

$$A = 2\pi rh \quad \text{Should have been [Arc length] } \times h$$

Curved surface area, A , of cone of radius r , sloping edge l .

$$A = \pi rl \quad \checkmark$$

Surface area, A , of sphere of radius r .

$$A = 4\pi r^2 \quad \checkmark$$

Volume, V , of prism, cross-sectional area A , length l .

$$V = Al \rightarrow h$$

Volume, V , of pyramid, base area A , height h .

$$V = \frac{1}{3}Ah$$

Volume, V , of cylinder of radius r , height h .

$$V = \pi r^2 h \quad \checkmark$$

Volume, V , of cone of radius r , height h .

$$V = \frac{1}{3}\pi r^2 h \quad \checkmark$$

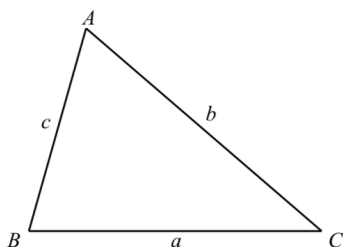
Volume, V , of sphere of radius r .

$$V = \frac{4}{3}\pi r^3 \quad \checkmark$$

For the equation, $ax^2 + bx + c = 0$, where $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For the triangle shown,



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area} = \frac{1}{2}ab \sin C \quad \checkmark$$

2D

You have to
memorize
all formulas.

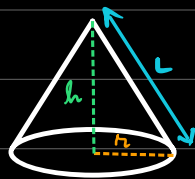
3D

Cube
Cuboid
Prisms

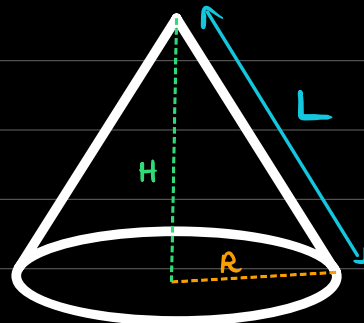
Cone is opened
Hemispheres.
Frustum

SIMILARITY

- 1) AAA = If all angles of two different sized shapes are equal, they are SIMILAR.
- 2) FOR SIMILAR SHAPES, RATIO OF CORRESPONDING LENGTHS IS EQUAL
Divide



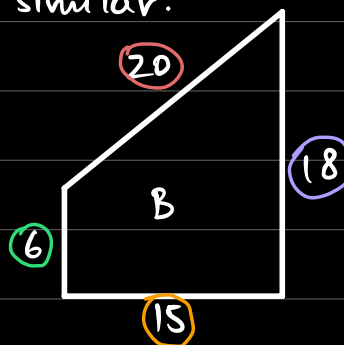
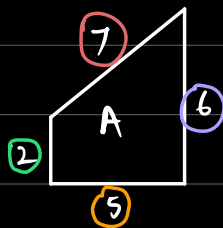
Cone 1



Cone 2

$$\frac{\text{Cone 2}}{\text{Cone 1}} = \frac{L}{L} = \frac{H}{h} = \frac{R}{r}$$

Q: Check if both shapes are similar.



$$\frac{\text{Shape B}}{\text{Shape A}} = \frac{6}{2} = \frac{15}{5} = \frac{18}{6} = \frac{20}{7}$$

3 3 3 Not 3

Shape A and B are not similar.

IF TWO SHAPES ARE **SIMILAR**,
WE DO NOT APPLY MENSURATION FORMULAS
TO FIND AREA & VOLUME.

AREA
 $\text{cm}^2, \text{m}^2, \text{km}^2$

$$\frac{A_1}{A_2} = \left(\frac{L_1}{L_2} \right)^2$$

$\frac{L_1}{L_2}$ = Ratio of corresponding sides.

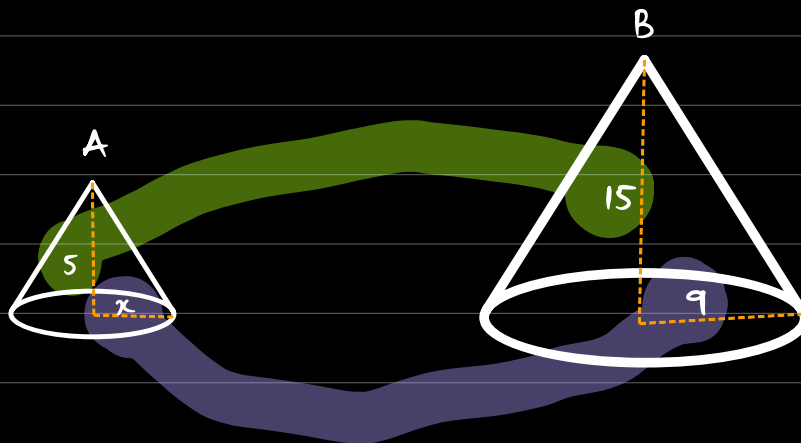
VOLUME
 $\text{m}^3, \text{cm}^3, \dots$

$$\frac{V_1}{V_2} = \left(\frac{L_1}{L_2} \right)^3$$

Mass
 $\text{g}, \text{kg}, \text{tons}$

$$\frac{M_1}{M_2} = \left(\frac{L_1}{L_2} \right)^3$$

Q. Cone A and Cone B are **Similar**. Find x .



$$\frac{15}{5} = \frac{9}{x}$$

$$15x = 45$$

$$x = 3$$

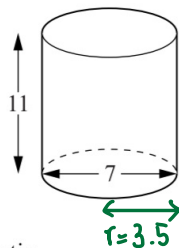
$$\frac{5}{15} = \frac{x}{9}$$

$$15x = 45$$

$$x = 3$$

- (b) A closed cylindrical tin is 11 cm high and the base has a diameter of 7 cm.

3 surfaces



- (i) Calculate the volume of this tin.

$$\begin{aligned} V &= \pi r^2 h \\ &= \pi (3.5)^2 (11) \\ V &= 423.3296 \end{aligned}$$

Answer 423.3296 cm³ [2]

(ii) Calculate the total external surface area of this tin.

$$\begin{aligned}
 1) \text{ Top } &= \text{circle} = \pi r^2 = \pi (3.5)^2 = 38.48451 \\
 2) \text{ Bottom } &= \text{circle} = \pi r^2 = \pi (3.5)^2 = 38.48451 \\
 3) \text{ CSA of cylinder } &= \left[\frac{\text{Arc length}}{\text{length}} \right] \times h = \left[\frac{9}{360} \times 2\pi r \right] \times h \\
 &= \left[\frac{360}{360} \times 2\pi (3.5) \right] \times 11 = 241.9026 \\
 \text{Total SA} &= 318.87165
 \end{aligned}$$

Answercm² [3]

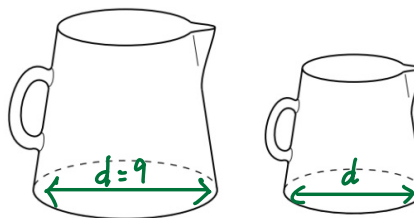
(iii) In addition to the surface area, a closed tin requires an extra 30 cm² of metal to allow the top, bottom and side to be joined together.

Calculate the area of metal required for 30 000 closed tins.
Give your answer in square metres.

$$\begin{aligned}
 1 \text{ complete tin} &= 318.87165 + 30 = 348.87165 \text{ cm}^2 \\
 &\quad \times 30000 \text{ tins} \\
 &= 10466149 \text{ cm}^2 \xrightarrow{\text{Rule: Divide by 100}} \text{m}^2 \\
 &= \frac{10466149}{(100)(100)} = 1046.6149 \text{ m}^2
 \end{aligned}$$

Answer m² [2]

(c) Two geometrically similar jugs have volumes of 1000 cm³ and 512 cm³.
They have circular bases.
The diameter of the base of the larger jug is 9 cm.



$$\begin{aligned}
 \frac{V_1}{V_2} &= \left(\frac{L_1}{L_2} \right)^3 \\
 \frac{1000}{512} &= \left(\frac{9}{d} \right)^3 \\
 \frac{1000}{512} &= \frac{729}{d^3} \\
 1000 d^3 &= 729 \times 512 \\
 d^3 &= \frac{729 \times 512}{1000} \\
 d^3 &= 373.248 \\
 d &= \sqrt[3]{373.248} = 7.2
 \end{aligned}$$

Answer 7.2 cm [3]